# AN ASSESSMENT OF INSTITUTIONAL ARRANGEMENTS IN THE YUKON RIVER BASIN FOR PLANNING, CONSTRUCTING AND OPERATING HYDROELECTRIC POWER FACILITIES

by

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YUKON RIVER BASIN STUDY

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Electric power generation is one of the major uses of water resources in the Yukon River Basin and the importance of this use could increase in the future. Except where sedimentation rates are high, hydroelectric projects have a long life. Operating costs, other than capital charges, are very low since they utilize a continually renewable supply of water. Once constructed, they are immune to inflation. On the other hand, such projects may bring about a major transformation of the bio-physical system over a large area, which frequently adversely affects other resource values.

The physical potential for hydroelectric power development in the part of the basin that lies in the Yukon is very substantial. The potential is much smaller in the B.C. portion of the basin, but the headwaters of the Yukon River could be diverted to the Taku River in British Columbia and provide the basis for generating up to 2,500 megawatts of power in the province. In the section of this report on "Legal and Administrative Arrangement for Yukon River Basin Water Management" existing laws, organizations and procedures relating to the planning, construction and operation of hydroelectric power facilities are described. This section seeks to define the institutional issues related to hydroelectric power development that arise in British Columbia and the Yukon Territory, and assess their implications for the design of institutional arrangements for water management in the two jurisdictions.

The physical and economic aspects of hydroelectric power development have an important bearing upon the kind of institutional arrangements required. First, hydroelectric projects directly affect other land and water uses in the region in which they are built. These

effects need to be assessed in arriving at the design and value of a hydro project. Second, consideration of potential hydroelectric power projects must take into account alternative ways of meeting electric power demands, such as through diesel or thermal generation, through conservation practices or through substitution of other forms of energy. Third, since electric power is widely regarded as an essential social service, and since power availability at low cost can be an important determinant of the viability of some energy intensive industries, electric power generation and distribution can be designed to serve social and economic objectives. In short, for hydroelectric power planning to produce optimal results, it must be integrated with overall electric power planning, with related land and water uses, and with efforts to achieve social and economic goals.

In addition to the issues arising out of the foregoing considerations applicable to hydroelectric power development in general, two others arise in the Yukon River Basin in Canada. One relates to the adequacy of existing arrangements for coordinating hydroelectric power planning and development in the two Canadian jurisdictions that share the upper part of the Yukon River Basin -- British Columbia and Yukon Territory. The other relates to the adequacy of existing arrangements for planning and deciding upon hydroelectric power projects that may affect both the Yukon and Alaska.

In the remainder of this statement issues relating specifically to the Yukon Territory are considered first. This is followed by a brief review of issues relating specifically to British Columbia. The final sections are concerned with international and Territorial/B.C. relationships.

## Hydroelectric Power Planning and Development in the Yukon Portion of the Yukon River Basin

In addition to the features common to hydroelectric power planning described above, there are specific aspects of conditions in the Yukon that must be considered.

First, because of its harsh climate, distance from sources of construction materials, and the need to secure professional expertise from some distance, construction costs tend to be high.

Second, the economy is quite small and the demand for electric power has been quite low in comparison with the provinces, so that large projects capable of producing power at low unit costs have not been justified.

Third, demand is dispersed over a very large area and some communities and industrial sites are remote from central station generating facilities and existing transmission lines. It would be impractical to connect these remote locations to existing transmission lines and existing central station facilities. The costs of power generated at these locations far exceeds the costs of generation at plants serving larger demands.

Fourth, the nature of the Yukon economy can result in major instabilities in demand. The major user of electric power in the Yukon until the recent recession has been the mining industry, which in the 1980-1981 fiscal year accounted for nearly half of the electric power consumed (Hildebrandt-Young and Assoc., 1981). Any significant

increase in electric power demand that may occur in the future will likely stem from the growth of mining and milling in the Territory. Because of its dependence upon world markets, activity of the mining industry tends to fluctuate widely. Hydroelectric power projects are not well suited to serve a volatile industry. Usually a quite long lead time is required to plan and construct a hydro project, which may handicap a mining venture that may require the power at an early date. Furthermore, hydroelectric projects are capital intensive in nature, with most of the annual cost being interest charges on the initial investment. As a result, if the power from a hydro project is surplus, closing the plant down or reducing its output does not result in a significant reduction in costs, because interest charges are not reduced thereby. Therefore, if facilities are constructed in advance of demand, the cost of interest charges on a capital intensive project must be met without supporting revenue until a market for the power materializes. Similarly in a small economy, such as exists in the Yukon, if world market conditions result in the closure of a mine, a hydroelectric power supplier is burdened with a facility that requires large capital payments without a revenue source with which to meet them.

Fifth, the Yukon government and probably the majority of Yukon residents aspire to a greater voice in public decisions relating to the Yukon. This has prompted the Yukon government to urge that it take over the responsibilities and facilities of NCPC for the generation and marketing of electric power.

Sixth, some feel that electric power services could be supplied more economically by the private sector, and urge that private companies be granted a larger role in the generation and marketing of electric power in the Yukon.

A number of issues arise out of the nature of hydroelectric power, characteristics of the Yukon economy; and the views that are held about how electric power institutional arrangements should be changed. It would not be practical and probably it would be inappropriate to examine all of these issues in this report. However, in order to provide a perspective on the overall situation, it is useful to identify the full range of issues that would need to be considered in a comprehensive treatment of the subject, identify the specific issues to be considered in this report, and indicate the rationale for covering only a portion of them.

A full listing of the issues would include the following:

1. <u>Is electric power planning organized and conducted so as to ensure an optimal response to electric power demands?</u>

An affirmative response to this issue would require that institutional arrangements be designed to take into account

(a) the uncertainties inherent in forecasts of future demand arising out of potential wide fluctuations in electric power demands in the Yukon;

(b) the adverse and beneficial effects of hydro power on other resource values;

(c) the potential availability of electric power from alternative hydro and non-hydro sources;

(d) possibilities for limiting electric power use through economically efficient conservation practices, and

(e) the possibilities for substituting lower cost sources of energy for electric power.

2. How should social and economic development policy considerations be taken into account in hydroelectric power planning and development?

This question has three aspects. One arises from the fact that electric power is generally more costly to generate in the Yukon than in southern Canada. Also, in remote locations with small demands generation and distribution costs are greater than in areas with a much higher level of demand. It has been past practice to provide subsidies in one form or another to reduce to some extent inequalities between the Yukon and southern Canada and among Yukon communities. Are procedures and practices for arriving at the amount and distribution of these subsidies satisfactory? A second aspect arises from the risks associated with development of hydroelectric power projects designed in large part to serve the mining industry. How should decisions with regard to the appropriateness of taking such risks be made and who should bear the cost of revenue shortfalls that result if power demands fail to materialize to use the capacity of a project? The third aspect involves the question of whether hydroelectric projects should be undertaken to promote economic development. Projects undertaken for this purpose will generally entail a risk and a question arises about how decisions on such matters should be made and who should bear the cost if the economic development that results is insufficient to utilize the power provided.

## 3. How should electric power utilities be regulated?

The Northern Canada Power Commission Act provides that the Commission will set its own rates, subject to approval by the Governor in Council. Rates are to be designed to cover the costs of supplying power, including the costs of interest on loans; repayment of principal; operating maintenance and repair expenses; administration; and a contingency allowance (currently set at four per cent of utility sales by Order-in-Council). Proposed rate schedules are voluntarily submitted for review by the Yukon Public Utilities Board but the Commission is not bound by the Board's reaction. The Yukon government has recommended that rates be regulated by the Board whereas in a recent report the National Energy Board recommended that "approval of rates and of the public convenience and necessity of major capital additions, should be assigned to a single federal regulatory agency" (August 1983 - page 6). Local interests in the Yukon have generally supported regulation by the Yukon Public Utilities Board.

Privately owned electric power utilities, such as Yukon Electrical Co. Ltd. (YECL), are regulated by the Yukon Public Utilities Board as to rates, capital additions, quality of service, and area to be served. YECL supports the view that both the NCPC and the privately owned utilities should be regulated by the Yukon Public Utilities Board.

4. What should be the role of the Territorial Government in the planning, development and operation of electric power systems in the Yukon?

The underlying issue is whether the federal government or the Yukon Government should have ultimate control over the policies of the public power agency in the Yukon. This question is closely related to the issue of how social and economic development policy matters should be decided (Question 2 above). Since it is generally accepted that subsidies for electric power are desirable to some degree an important aspect of this question is whether the Territorial Government would be expected to provide such subsidies if it assumed the responsibilities of NCPC or whether the federal government would continue to provide some financial support. If federal funds are invested in an electric power generating and transmission organization operated by the Yukon Government, what voice should the federal government have in the policies of the organization and how should this voice be exercised?

5. What should be the role of the private sector in the planning, development and operation of electric power systems in the Yukon?

Currently YECL has a substantial role in generating and marketing electric power in the Yukon. In addition individual mines have generated power to serve their own needs. Three questions arise. First, should formal arrangements be established to involve these private sector organizations in planning programs to meet future needs? Second, could private organizations such as YECL generate and distribute power more economically than a public agency? Third, how

would social and economic policy of government be implemented through private organizations? That is, how would subsidies designed to reduce inequalities among areas be provided and how would policies to utilize electric power development to foster mining and promote economic development be implemented if such policies are viewed as desirable?

* * * * * *

The House of Commons subcommittee on the Northern Canada Power Commission considered most aspects of these issues in its report on Electric Power North of 60°. In addition, the National Energy Board recently completed a report on rate matters and regulation related to the Northern Canada Power Commission (August, 1983). In view of the attention that has already been devoted to these issues, and the resources that have been applied to the investigation and analysis of them, there is no point in re-examining all of them in this study. We believe it would be most fruitful to limit our analysis to the first of the foregoing questions, namely the institutional problems associated with the organization and conduct of electric power planning in the Yukon.

## Electric Power Planning in the Yukon

### A. Existing Practices

The first step in this analysis is to determine the ways in which existing institutional arrangements are designed so as to respond to electric power demands and to achieve coordination with economic and social development policies.

It has been the practice of the NCPC to have forecasts of demand made at periodic intervals. These forecasts generally include a high and a low, as well as a best estimate. We are not aware of any planning documents that assess the consequences of errors in the forecast or which examine the economic effects of alternatives for dealing with major declines or increases in demand. If this is an accurate reflection of existing practice, it indicates an important deficiency in existing planning processes. The point is that the uncertainties should be weighed so that those responsible for final decision and funding will know what the upside and downside effects will be if possible changes in demand materialize.

The effects of hydro-power projects on the other resource values are currently considered in a variety of ways. It is the policy of NCPC to undertake social and environmental impact assessments of projects being given serious consideration. In order to undertake a hydroelectric power project, NCPC must apply for a licence to the Water Board, which holds hearings on the licence. This permits intervenors to present information on social and environmental effects and other resource values. Any hydroelectric project is subject to the Federal Environmental Assessment Review Process. If a project is selected for review, public hearings are held at which the social, environmental and economic consequences of the project are considered.

The NCPC has investigated a number of potential hydroelectric power projects in the small and medium range to assist in the selection of future generating sites for development. Diesel power has been relied upon by NCPC to supplement its hydro facilities because of its

low capital cost, the short lead time required to bring new facilities into operation, and the ability to reduce costs quickly by eliminating the use of fuel if demand declines. Yukon Electrical Co. Ltd. makes its own forecasts of demand for the areas it services. The Yukon government has sponsored studies of future energy requirements of the Yukon and potential ways of meeting these needs. Private organizations have made studies and reported upon the possibilities of using coal from the Bonnet Plume area as a possible source of energy for electric power generation. The federal Department of Energy, Mines and Resources has funded a nationwide study of soft energy paths, one component of which deals with the Yukon and Northwest Territories (Hodge and Ehrlich). This study takes into account opportunities for substituting lower cost energy sources for higher cost sources.

We know of no explicit procedures for relating electric power development plans to economic and social development policies. On the other hand, there have been comments in the press about possibilities for constructing a large hydro project in the Yukon to supply electricity to an aluminum smelter which could employ 1,000 to 1,500 people and stimulate a large amount of secondary employment.

Can these planning practices be expected to produce optimal results? If not, what are their shortcomings and to what deficiencies in institutional arrangements can the shortcomings be attributed?

B. Shortcomings in Existing Practices

The following shortcomings in existing practices are evident:

1. Procedures do not exist to assure the coordination of plans of NCPC and private organizations to expand or alter generation and transmission facilities, to extend service or to provide interconnections.

Such coordination as now exists is entirely dependent upon informal contacts among representatives of the various organizations.

2. Past and current planning practices do not include systematic analysis of the implications of potential wide fluctuations in the demand for electric power in the Yukon.

The forecasts sponsored by NCPC do include high, low and medium estimates. NCPC has resisted pressures to construct additional hydro projects, except for the Fourth Wheel at Whitehorse -- which indicates a sensitivity to the uncertainties in demand forecasts. However, we are not aware of a set of sensitivity analyses that compares the costs and benefits for different development programmes and differing demand scenarios over time. Unless this is done, decision makers cannot be well informed about the risks associated with alternative decisions.

3. Past and current planning practices lack a systematic basis for taking into account resource values affected by hydro development.

Currently, resource values affected by a proposed hydro facility are taken into account through estimates of land acquisition costs by the proponent organization, through environmental impact assessments, and through hearings of the Water Board and possibly FEARO. Environmental impact assessment processes are far from exact at the present time and are readily susceptible to bias. While hearing processes are valuable, intervenors may not have the resources to make systematic assessments of affected resource values. Furthermore, it is not practicable to make a valid assessment of resource values at one location without knowledge of plans for utilization of similar resources at other locations.

4. There is no evidence that electric power planning in the Yukon involves (a) a comparison of a full range of non-hydro alternatives, (b) an assessment of opportunities for conservation, and (c) an assessment of opportunities for substituting less costly forms of energy for electric power.

Certainly studies made in recent years have made Yukon residents sensitive to these possibilities. What is lacking is the adoption of practices which first produce an evaluation of alternatives to a hydro or diesel plant in the same degree of detail and rigour as the evaluation of the hydro and diesel plant itself, and second, provide the design of a programme and policies that would need to be adopted to implement such alternative programmes. While coal and

natural gas have been suggested as potential sources of thermal electric power and as substitutes for electric power, we have found little in the way of comparative analyses of these alternatives. There is a great deal of general information on opportunities for electric power conservation, but to our knowledge a specific programme and arrangements for its implementation have not been developed for consideration.

C. Institutional Deficiencies Responsible for Shortcomings

Broadly speaking there appears to be two major deficiencies in the existing institutional structure that account for the shortcomings in existing practices identified above.

First, there does not exist at the present time a structure for integrated resource use planning for the Yukon which coordinates resource use plans with one another in order to assure optimal use of such resources. Lacking such a structure, the basis does not exist for taking into account all resource values in planning electric power generating facilities. This problem is discussed more fully in the section of this report entitled Water Management in the Yukon Territory: Integration with Land Use Planning.

Second, there does not exist a formal structure and established procedures for integrating energy use planning for the Yukon. Relevant activities are being undertaken by private organizations (e.g. Yukon Electrical Co. Ltd. and the mining companies) as well as NCPC, the Government of Yukon and federal agencies. However, no provision has been made for the leadership required to bring these organizations together, to pool their information and to undertake such additional studies and investigations as are necessary to assess the

implications of alternative energy policies and programmes in the Yukon. The Subcommittee on the Northern Canada Power Commission proposed a planning council "made up of representatives from the government utilities, private utilities and other producers and consumers of electrical power" that would prepare and annually update an electrical energy plan for each Territory (page 44). They also recommend that a long-term energy policy be prepared for each Territory. Our own recommendations below includes some features of this proposal.

## D. Strengthening Institutional Arrangements

In deciding upon the specific nature of the institutional arrangements for integrating energy use planning for the Yukon, there are several considerations that should be taken into account. One is that in view of the modest size of the Yukon economy, an elaborate structure cannot be justified to serve this purpose. A second consideration is that energy use planning needs to be fully coordinated with land and water use planning and reflect the effects of alternative economic and social policies upon energy plans. Third, the regulation of electric power agencies by the Water Board, the Public Utility Board, and any other government entities should take into account the results of a coordinated energy planning activity and the relationship of energy plans to overall land and water use plans for the territory. Fourth, it is of critical importance that a full range of interests be involved in whatever structure is established for energy use planning.

In modifying the existing institutional structure to take into account the foregoing considerations it would be logical for the Yukon Government to provide leadership in coordinating the views and

activities of the various interests. Its concerns extend well beyond electric power to energy policy generally and it represents the people most directly affected by energy use programs in the Territory.

In the interest of simplification and to facilitate communication, it would appear desirable for the energy use planning activity to be an integral part of the land and water use planning process. In other words instead of setting energy use planning up separately, the overall structure for land and water planning should be so designed that the results of energy use planning will feed into the land and water use planning process and similarly the results of investigations and an analysis of other components of land and water resource planning would be taken into account in energy use planning.

It is assumed that the Water Board will be guided by laws and regulations and by the results of the overall resource planning process. Its assessment of a hydroelectric power proposal would therefore involve assuring itself that the proposal accords with land and water use plans and that the investment involved meets with the approval of the electric power regulating bodies.

The importance of having a range of interests involved in the energy use planning process deserves emphasis. It is well established by studies of decision making that a small group with similar interests and values will generally reach agreement quite readily but they are not likely to take into account all of the interests and values affected. In the private sector, competition in the market requires that a wide range of interests and values be taken into account. Where

public decision-making is involved it is necessary to involve in the planning process a wide range of interests to bring about a rigorous examination of proposed plans and to assure that all relevant alternative possibilities are considered. Unless this is done there will be a tendency to neglect some alternatives (e.g. possible use of coal in the Yukon) and quite possibly to fail to examine rigorously the risks associated with some development proposals. In order for a wide range of interests to be involved in energy use planning, it may be necessary to provide public funding for those groups that do not have a direct economic interest in energy use policies. This would be necessary to make it possible for them to devote the time and staff resources required to play a constructive part in the process.

In short our proposal for a system of energy use planning in the Yukon differs from that of the House of Commons Subcommittee on the Northern Canada Power Commission in that we recommend that the Yukon Government provide leadership for the planning group, that this group include others than those who supply energy or are large users, and that energy use planning be integrated with land and water planning.

## Conclusion

There are two major deficiencies in existing institutional arrangements for hydroelectric power planning in the Yukon, namely the lack of a system of land and water resource planning to which hydroelectric power proposals can be related and the lack of a formal system for relating hydroelectric plans to overall energy use plans.

Land and water use planning is considered in a separate section of this report. With regard to energy use planning, we have concluded that it would be appropriate for the Yukon Government to provide leadership in coordinating the views and activities of a wide range of concerned interests. We envisage this activity as being integrated with overall resource use planning in the Territory. The results of such planning would be taken into account by the Water Board and other entities responsible for regulating the generation and distribution of electric power.

## Hydroelectric Power Planning and Development in the British Columbia Portion of the Yukon River Basin

In the British Columbia portion of the Yukon River Basin there are two hydroelectric power potentials which conceivably could be developed at some future date. One is the regulation of storage in Atlin Lake to augment power output at the Whitehorse Rapids hydroelectric plant in the Yukon. The other involves storage of water in the headwater lakes of the Yukon River Basin and diversion of supplies to the Taku River in British Columbia which flows in turn through the panhandle of Alaska. The basic question, therefore, is whether institutional arrangements applicable to British Columbia are adequate to protect the interests of the people of the province as they may be affected by such developments. We have been unable to locate any information that indicates that potentials exist for developing generating facilities in the B.C. portion of the basin that would be supplied solely by the water resources of that area.

Provincial/Yukon Territory relationships and the international aspects of utilizing the foregoing potentials are considered in the sections of this report which immediately follow this one. In this section the question of concern is whether provincial institutions are so designed as to provide reasonable assurance that provincial interests will be defined and appropriately served in future planning for these potential developments.

Because of its substantial population and economy and its highly developed electric power system, British Columbia has a well developed set of institutional arrangements for dealing with electric power. These arrangements relate to all aspects of electric power planning, development and operation but we will limit ourselves to the adequacy of planning arrangements for dealing with the two potentials identified.

With regard to the Atlin storage proposal the Strategic Planning Process which has been utilized in some of the smaller basins of British Columbia could appropriately be applied in that portion of the Yukon River Basin which lies in British Columbia. Through that process potential uses of the water and associated resources in British Columbia would be identified and evaluated. This would provide in turn a basis for estimating the potential effects of Atlin storage and would place British Columbia in a well informed position to negotiate with hydroelectric power developers in the Yukon (e.g. NCPC) about the desirability of such storage and the terms of any agreement to provide it, if such action proved to be desirable.

The Strategic Planning Process has been applied in very few basins in British Columbia. In view of the current restraint program a question arises as to whether the Strategic Planning Process is likely to be applied in the Yukon River Basin in British Columbia. This may not be a serious matter if the Atlin Development does not prove to be desirable to the Yukon. When and if it does prove to be desirable, failure of British Columbia to provide a basis for arriving at an informed decision on this proposal could make constructive negotiation infeasible because the lack of a good assessment of resource values in British Columbia would mean that British Columbia would not be in a good position to specify terms and conditions that would accord with the best interests of the people of British Columbia.

In short there does not appear to be an institutional problem that would militate against action by British Columbia to evaluate the implications of storage in Atlin Lake for downstream hydroelectric power generation. Procedures and processes are available which could serve this purpose. The question is whether British Columbia would have sufficient motivation to apply the resources required to make an evaluation. If government priorities militate against such action, no institutional change can be expected to alter the situation.

The Taku Diversion would bring into play a different set of procedures and processes. Should this project be seriously considered by British Columbia, leadership would no doubt be taken in the province by the B.C. Hydro and Power Authority. Since the project would directly affect the Yukon and Alaska, provincial/territorial and international relationships would be involved. These are considered in

the concluding sections of this report. It seems likely that within British Columbia the pattern recently followed for the Site C project on the Peace River would apply. A detailed investigation would be undertaken and reports would be submitted to the Utilities Commission. These reports would be subject to review by the Commission at probably a public hearing. The Commission would then, in turn, make its recommendations to the provincial cabinet. If favourably considered and if the international and British Columbia/Yukon Territorial hurdles are overcome an application for a water licence would be made to the provincial Water Comptroller.

A thoroughgoing assessment of these processes would be an enormous task and would entail careful analysis of the experience and performances of the various entities (B.C. Hydro, the Utilities Commission, the Ministry of Energy, Mines, and Petroleum Resources, and the Water Comptroller). A major question that would need to be addressed is whether the system assures balanced consideration of alternative ways of responding to future electric power demands. The enormity of this task combined with the fact that the Taku-Diversion is unlikely to be seriously considered for two or three decades has led us to conclude that a detailed analysis of the intra-provincial institutional issues is not justified in the context of a study of the Yukon River Basin.

## Institutional Arrangements for Cooperation of British Columbia and the Yukon Territory in Developing and Managing the Hydroelectric Power Resources of the Yukon River Basin

The only formal institutional arrangements for the cooperation of British Columbia and the Yukon Territory in developing the hydroelectric power resources of the Yukon River Basin are the Canada Water Act and the procedures and processes based thereon. Since those sections of the Canada Water Act that apply to cooperative investigations and planning only become operable when positive steps by the affected jurisdiction are taken to utilize them, there are no continuing arrangements that exist for such cooperation.

In the Saskatchewan River Basin an agreement exists among the federal government and the provinces which share the basin on a quantitative apportionment of the basin's water supplies. In the United States there are a number of instances where the states that share a basin have made similar arrangements. In at least two instances (the Delaware and Susquehanna river basins) a group of states that share a basin have worked out continuing arrangements that deal with hydroelectric power development, pollution control and flood control. In view of these practices elsewhere a question arises as to whether the procedures and processes of the Canada Water Act are sufficient to meet future needs for cooperation in the Yukon River Basin. It should be kept in mind that if an inter-jurisdictional arrangement for continuing cooperation were worked out it would need to include the federal government as well as the governments of British Columbia and Yukon.

As noted in the preceding section of this report, there are two potential hydro-related developments that could affect both British Columbia and the Yukon, namely storage in Atlin Lake to increase power output downstream in the Yukon and the proposed Taku Diversion. The Atlin Lake storage proposal could become a live issue in the next few years if electric power demands increase in the Yukon. With the installation of the Fourth Wheel in the Whitehorse Rapids plant additional upstream storage would make possible a significant increase in power generation at Whitehorse Rapids. Currently there is no evident demand for a block of power of the size that would be produced by the Taku Diversion. If this development is ever undertaken it seems unlikely to occur for several decades.

The Canada Water Act is not designed to deal with the specific allocation of water supplies and services among jurisdictions, (except with regard to the management of water quality) and it has never been applied to serve this purpose. For example, in the MacKenzie River Basin, the report that resulted from a basin study in accord with the Canada Water Act recommended that the affected jurisdictions negotiate an agreement on the sharing of the basin's water resources but no effort was made by the participants in the study to negotiate or recommend a specific arrangement.

In the Yukon River Basin it does not appear timely for the affected jurisdictions to work out a continuing arrangement for cooperative action. If and when the Atlin storage matter warrants serious consideration it would be desirable for the federal government, the British Columbia government and the Yukon government to reach an

understanding with regard to responsibilities for the conduct of investigations, the preparation of plans, and the procedures to be followed in arriving at a joint decision. Should the Taku Diversion development reach the stage where it is seriously considered, a quite different and more elaborate arrangement for cooperative action would be necessary. This project would no doubt involve negotiations with the United States; it would be very costly; and the biophysical, social, and economic consequences for both the Yukon and British Columbia would be enormous.

In short the upper Yukon River Basin situation is quite different from situations in basins where joint agreements have previously been negotiated. There is no need to reach an early agreement on how the resource should be shared as there are no on-going activities involving the use of water resources that threaten to affect adversely the interests of one or the other jurisdictions. No developments are in immediate prospect that require joint action. Neither the Yukon nor British Columbia is likely to proceed unilaterally with a development program to the possible detriment of the other or to undertake a development program unilaterally that would preclude the realization of greater benefits through joint action. Future prospects are quite uncertain and the two potentials that are now envisaged differ very greatly from one another. Under these circumstances it would appear wise to wait until the demand for development can be specifically defined and then to work out arrangements for cooperation in accord with the specific conditions that exist at that time.

## Institutional Arrangement for Cooperation of Canada and the United States in Developing and Managing the Hydroelectric Resources of the Yukon River Basin

Several possibilities exist for the development of hydroelectric power resources that would involve utilization of the water resources of the Yukon River Basin and which could directly affect the interests of both the United States and Canada.

One is the Taku Diversion to which reference has already been made. Should this storage and diversion scheme be undertaken, the flow regime of the Taku river would undergo a major change because large additional supplies of water from the Yukon would augment the natural flows of the Taku. This could, in turn profoundly affect physical and biological conditions in the mainstem and delta of the river in Alaska. In addition flows of the Yukon River below the storage area would be reduced which could conceivably reduce hydroelectric power potentials in the Alaska portion of the basin. Also, the dams used to raise water levels in the headwater lakes could impair salmon migrations.

A second possibility is the proposed Taiya Diversion project which is an alternative to the Taku Project inasmuch as it would divert water stored in the headwater lakes of the Yukon River system to the Taiya River in order to generate a large block of power in Alaska.

A third possibility is the Mid-Yukon Project which has been investigated by a consulting firm under contract with Northern Canada Power Commission. This project would store the flows of the upper

Yukon River for the generation of electric power. Since it would rely upon the same flows and some of the same storage areas as the Taku and Taiya projects, it is an alternative to them. Its effects upon Alaskan interests are not entirely clear. It would undoubtedly block salmon runs of interest to that state and conceivably it would alter the flow regime of the Yukon in Alaska to some extent. Furthermore, under the Treaty of Washington of 1871 the Yukon River is to be open to navigation on a reciprocal basis to the nationals of both countries. Evidently on the basis of this treaty the United States could object to the construction of a dam on the Yukon River which would preclude navigation of the river by Americans unless locks were provided. Since the river is used very little for navigation at this time such an objection may be unlikely.

A fourth possibility is the construction of a major dam and a power plant in the Yukon River in Alaska, such as the Rampart Canyon dam that was considered a number of years ago. Such a dam would interfere with salmon runs to the Yukon Territory and block navigation unless navigation locks were provided.

We know of no other hydroelectric power potentials in the Upper Yukon that are of joint interest to the two countries. If very large quantities of electric power were eventually demanded in the North it is possible that an integrated system of storage and generating facilities in the Yukon River Basin in British Columbia, Yukon, and Alaska could be devised as has been done in the Columbia River Basin but we know of no studies of such a possibility and at the present time the demand for such a large block of power is not in prospect.

The Boundary Waters Treaty of 1909 establishes mechanisms and procedures for dealing with the kinds of problems that could arise if it were proposed to undertake one of these projects. In the case of the Taku Diversion, if water levels in the Taku River were significantly altered, the International Joint Commission (IJC) provided for by the Treaty would be required to approve alteration of the water levels before the project could proceed. While there is an argument that the Treaty may not be applicable to the Alaska-Yukon boundary, if the Treaty appplies, the International Joint Commission has jurisdiction -- even without a reference from the governments if the project alters water levels in a boundary water. In the case of the Taiya Project, joint action by the two countries could not be avoided because the water would come from Canadian sources and the power would be generated in the United States. A procedure similar to that used for the Columbia River would probably be followed. In that case the International Joint Commission was requested to investigate and report on the alternatives. These studies were followed by direct negotiations between the two governments which led in turn to the Columbia River Treaty. If the United States became concerned about plans to develop the Mid-Yukon project it could request that the matter be referred to the IJC for investigation and recommendation. The same procedure could be followed by Canada, if concern arose over proposed construction of a dam in Alaska.

The International Joint Commission (IJC) has a very good record and is widely considered to be the most effective institution of its kind concerned with international water resources. It is evident that if conditions should develop so that one of the four possibilities described warranted serious consideration, the two countries could

employ the IJC to investigate the proposal and provide a report that would serve as a basis for action by the two governments. If the Taku Diversion were proposed it seems likely that approval of water levels in the Taku River by the IJC would be required.

At the present time there appears to be little point in establishing additional arrangements for international cooperation with regard to use of the water resources of the basin for hydroelectric development. If in the future one or more of the various potentials merits serious consideration, it may be desirable to refer the matter to the IJC for investigation and recommendation. Its report could lead to the establishment of specific arrangements for further cooperative action as occurred in the Columbia River and with respect to the control of pollution in the Great Lakes. While responsibility for international negotiations rests with the federal government, it would need to coordinate its actions with British Columbia because of provincial control of water resources. While the federal government has jurisdiction over water resources in the Yukon, it would also be desirable for the federal government to coordinate its efforts with the Yukon Government which would have a primary interest in any development that takes place.

It would be a fruitless exercise to establish a special international cooperative arrangement for the Yukon River Basin until it becomes clear what kind of development warrants consideration. This conclusion applies to hydroelectric power only. Some type of international cooperative arrangements besides those that now exist may be justified in the near future to manage the salmonid fishery resources of the Yukon River Basin. We have not explored this possibility.

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